IN THE CLAIMS:

1. (Currently Amended) In a file server having a storage operating system, a method for managing storage of data in a plurality of storage devices, each storage device having a plurality of blocks for storing data, comprising:

generating block layout information in a file system layer of the storage operating system by determining which blocks within the plurality of blocks are allocated for storing data and which are unallocated;

transferring the block layout information from the file system layer to a RAID layer of the storage operating system; ~~and~~

responsive to the block layout information, controlling ~~the~~ execution of I/O operations at the RAID layer by identifying a plurality of contiguous blocks on a single storage device within the plurality of blocks for use by each I/O operation so as to substantially maximize chain lengths of read operations for calculation of parity;

determining whether a parity subtraction method or a recalculation method requires a fewest number of read operations to calculate parity for the I/O operations;

selecting the~~a~~ parity subtraction method or the~~a~~ recalculation method for parity calculation based on ~~the~~ which method ~~that~~ requires the~~a~~ fewest number of read operations ~~to compute parity for the I/O operations~~; and

responsive to the block layout information and the parity calculation method selected, identifying the contiguous blocks within the plurality of blocks for use by the I/O operations.

2. (Currently Amended) A method for managing storage of data in a plurality of storage devices, each comprising a plurality of storage blocks, comprising:

generating block layout information;

determining whether a first methodology or a second methodology requires a fewest number of read operations to calculate parity; and

in response to the block layout information and the determination, controlling execution of I/O operations by identifying a plurality of contiguous storage blocks on a single storage device for use by each I/O operation so as to substantially minimize a~~the~~

9   number of read operations needed for calculation of error correction parameters across a

10   stripe disposed among the plurality of storage devices.

1   3. (Original) The method of claim 2 wherein the calculation of error correction

2   parameters comprises the calculation of parity.

1   4. (Currently Amended) The method of claim ~~3~~ 2 wherein the calculation of parity

2   comprises selecting a parity calculation operation from a group consisting of a

3   subtraction method as the first methodology and a parity re-calculation method as the

4   second methodology.

1   5. (Currently Amended) The method of claim 2 wherein the identification of contiguous

2   storage blocks for use in the I/O operation substantially maximizes a chain length by

3   substantially maximizing ~~the~~ a number of blocks having a contiguous physical layout on

4   the single storage device.

1   6. (Currently Amended) The method of claim 2, further comprising:

2   identifying the contiguous storage blocks for use in the I/O operation so as to

3   substantially maximize the chain length by substantially maximizing ~~the~~ a number of

4   blocks having sequential volume block numbers (VBNs) associated with the plurality of

5   storage blocks.

1   7. (Currently Amended) The method of claim 2, further comprising:

2   identifying the contiguous storage blocks for use in the I/O operation so as to

3   substantially maximize the chain length by substantially maximizing locality of the

4   contiguous blocks of the single storage device.

1   8. (Currently Amended) The method of claim 2 wherein ~~the~~ controlling execution ~~step~~

2   comprises:

3

3 examining ~~storage~~ blocks to which data is to be written prior to write operations;

4 and

5 selecting ~~one of a plurality of parity calculation methodologies including~~ either,

6 ~~a~~ the first methodology comprising minimizing a number of blocks read, ~~and~~ or

7 ~~a~~ the second methodology comprising maximizing chain lengths of blocks read

8 for calculating parity ~~calculation~~.

1 9. (Currently Amended) The method of claim 8, wherein ~~the~~ controlling execution ~~step~~

2 further comprises:

3 implementing selection of the parity calculation methodology responsive to the

4 block layout information; ~~and~~

5 wherein, if the selection constitutes ~~substantially~~ minimizing the number of

6 blocks read,

7 determining on a stripe-by-stripe basis whether to calculate parity based on a

8 subtraction method or a recalculation method,

9 performing any appropriate read operations to support the method selected, and

10 calculating parity responsive to the number of blocks read and the data to be

11 written; and

12 wherein, if the selection constitutes ~~substantially~~ maximizing chain lengths of

13 blocks read,

14 deciding which storage blocks to read to ~~substantially~~ maximize chain length

15 while ~~substantially~~ minimizing the number of ~~storage~~ blocks read to support either ~~a~~ the

16 subtraction method or ~~a~~ the recalculation method,

17 performing read operations on the number of blocks ~~to be~~ read, and

18 calculating parity responsive to the number of blocks read and the data to be

19 written.

1 10. (Currently Amended) The method of claim 2, wherein ~~the identification of~~ identifying

2 the contiguous storage blocks is based at least in part on an available resource.

1   11. (Original) The method of claim 2 further comprising transmitting the block layout

2   information from a file system layer to a RAID layer.

1   12. (Currently Amended) The method of claim 2 wherein ~~the~~ generating ~~step~~ further

2   comprises:

3   making a first determination as to whether a storage block is unallocated;

4   making a second determination as to a current implementation of the plurality of

5   storage devices; and

6   generating the block layout information based at least in part on the first and the

7   second determinations.

1   13. (Currently Amended) The method of claim 2, wherein the I/O operation is one of a

2   plurality of I/O operations and <u>at least</u> one of the plurality of I/O operations is a read

3   operation.

1   14. (Currently Amended) The method of claim ~~2~~ <u>5</u>, wherein the chain length is a ~~chain~~

2   length of a read operation for calculation of parity.

1   15. (Currently Amended) The method of claim ~~2~~ <u>5</u>, wherein the chain length is a ~~chain~~

2   length for a write operation for the data.

1   16. (Currently Amended) A method for managing storage of data in a storage system<u>,</u>

2   comprising:

3   maintaining a plurality of storage devices each having a plurality of storage

4   blocks; <u>and</u>

5   writing data to predetermined storage blocks <u>of the plurality of storage blocks</u>

6   across a plurality of stripes and to predetermined contiguous storage blocks within each

7   storage device so as to ~~substantially~~ maximize chain length<u>s</u> of <u>the predetermined</u>

8   <u>contiguous</u> storage blocks within each storage device and minimizing a number of read

9   operations for the calculation of error correction parameters across each stripe of the

10 | plurality of stripes by <u>determining whether a parity subtraction method or a recalculation</u>

11 | <u>method requires a fewest number of read operations to calculate parity, and</u> selecting the~~a~~

12 | parity subtraction method or the~~a~~ recalculation method for parity calculation based on ~~the~~

13 | <u>which</u> method ~~that~~ requires the fewest number of read operations ~~to compute parity~~.

1 | 17. - 38. (Cancelled)

1 | 39. (Currently Amended) A storage system<ins>,</ins> comprising:

2 | a plurality of storage devices each having a plurality of storage blocks; and

3 | a storage manager in communication with the plurality of storage devices, the

4 | storage manager <u>configured to write</u> ~~writing~~ data to predetermined storage blocks across

5 | a plurality of stripes and to predetermined storage blocks within each storage device so as

6 | to substantially maximize chain length of <u>the plurality of</u> storage blocks by selecting as

7 | many ~~as~~ contiguous storage blocks within a single storage device while ~~substantially~~

8 | minimizing a number of read operations required for calculation of error correction

9 | parameters across each stripe of the plurality of stripes by <u>determining whether a parity</u>

10 | <u>subtraction method or a recalculation method requires a fewest number of read operations</u>

11 | <u>to calculate parity and</u> selecting ~~a~~<u>the</u> parity subtraction method or ~~a~~<u>the</u> recalculation

12 | method for parity calculation based on ~~the~~ <u>which</u> method ~~that~~ requires the fewest number

13 | of read operations ~~to compute parity~~.

1 | 40. (Currently Amended) A system for managing the storage of data, ~~the system~~

2 | comprising:

3 | a plurality of storage devices each having a plurality of storage blocks;

4 | a storage device manager in communication with the plurality of storage blocks;

5 | a block layout information generator in communication with the storage device

6 | manager and the plurality of storage blocks; and

7 | an error correction parameter calculator in communication with the plurality of

8 | storage blocks and the storage device manager,

9   wherein the storage device manager, in response to the block layout information

10   from the block layout information generator, controls ~~the~~ execution of an I/O operation

11   by identifying a plurality of contiguous storage blocks on a single storage device for use

12   by the I/O operation so as to ~~substantially~~ maximize chain length within the <u>single</u>

13   storage device while ~~substantially~~ minimizing ~~the~~ <u>a</u> number of read operations required

14   for calculation by the error correction parameter calculator of error correction parameters

15   across a stripe by <u>determining whether a parity subtraction method or a recalculation</u>

16   <u>method requires a fewest number of read operations to calculate parity for the I/O</u>

17   <u>operations and</u> selecting ~~a~~ <u>the</u> parity subtraction method or ~~a~~ <u>the</u> recalculation method for

18   parity calculation based on ~~the~~ <u>which</u> method ~~that~~ requires the fewest number of read

19   operations ~~to compute parity~~.

1   41 - 44. (Cancelled)

1   45. (Currently Amended) A method for managing storage of data by a server,

2   comprising:

3   receiving a request to write <u>the</u> data to a plurality of storage devices;

4   generating block layout information to determine which blocks within a plurality

5   of blocks located in the plurality of storage devices are allocated ~~for storing data~~ and

6   which are unallocated;

7   identifying blocks within the plurality of blocks for use by a set of I/O operations

8   ~~to store the data~~;

9   determining ~~the~~ <u>a</u> number of read operations needed to ~~compute~~ <u>calculate</u> parity

10   for the data by ~~computing~~ <u>calculating</u> parity using a subtraction method ~~of computing~~

11   ~~parity~~;

12   determining ~~the~~ <u>a</u> number of read operations needed to ~~compute~~ <u>calculate</u> parity

13   for the data by ~~computing~~ <u>calculating</u> parity using a recalculation method ~~of computing~~

14   ~~parity~~;

15   choosing either the subtraction method of ~~computing~~ <u>calculating</u> parity or the

16   recalculation method of ~~computing~~ <u>calculating</u> parity by determining which ~~of these two~~

17 methods requires ~~the~~ a fewer number of read operations, and choosing the which method

18 that requires ~~requiring~~ the fewer number of read operations; and

19   writing the data to the identified blocks, and ~~computing~~ calculating parity for the

20 data using the ~~chosen~~ which method ~~of computing parity~~.

1 46. (Currently Amended) The method of claim 45, further comprising:

2   choosing to either ~~firstly~~ maximize chain lengths of read operations for

3 ~~calculation of~~ calculating parity or ~~secondly~~ choosing to place the data with a high degree

4 of locality in the plurality of storage devices, by choosing the which method ~~which~~ that

5 requires the ~~fewest~~ fewer number of read operations ~~in computing parity for the data~~.

1 47. (Currently Amended) A method for managing storage of data by a server,

2 comprising:

3   receiving a request to write data to a plurality of storage devices;

4   generating block layout information to determine which blocks within a plurality

5 of blocks located in the plurality of storage devices are allocated ~~for storing data~~ and

6 which are unallocated;

7   identifying blocks within the plurality of blocks for use by a set of I/O operations

8 to store the data; and

9   ~~selecting~~ determining, in response to the block layout information, whether to

10 ~~substantially~~ minimize ~~the~~ a number of read blocks or whether to ~~substantially~~ maximize

11 chain lengths of read blocks based on which method requires a fewer number of read

12 operations, and

13   implementing ~~the~~ a selection, during the writing of the data to the plurality of

14 storage devices, responsive to the block layout information, and responsive to whether

15 ~~substantially~~ minimizing the number of read blocks or substantially maximizing chain

16 lengths of read blocks requires the fewer number of read operations.

1   48. (Currently Amended) The method of claim 47, further comprising:

2   in response to selecting to ~~substantially~~ minimize the number of read blocks,

3   determining whether to calculate parity based on ~~the~~ a subtraction method or ~~the~~ a

4   recalculation method ~~by determining~~ based on which method requires the fewer number

5   of read operations~~, and selecting the method which requires the fewer number of read~~

6   ~~operations,~~; and

7   performing the write operation and calculating the parity using ~~the~~ which parity

8   calculation method ~~requiring~~ requires the fewer number of read operations.

1   49. (Currently Amended) The method of claim ~~48~~ 47, further comprising:

2   in response to selecting to ~~substantially~~ maximize chain lengths of read blocks,

3   deciding which storage blocks to read to ~~substantially~~ maximize chain lengths while

4   minimizing the number of storage blocks read to support either the subtraction method or

5   the recalculation method ~~of parity calculation~~; and

6   performing the write operation and calculating the parity using ~~the~~ which parity

7   calculation method ~~requiring~~ requires the fewer number of read operations.

1   50. (Currently Amended) A method for managing storage of data by a server,

2   comprising:

3   receiving a request to write data to a plurality of storage devices;

4   generating block layout information to determine which blocks within a plurality

5   of blocks located in the plurality of storage devices are allocated ~~for storing data~~ and

6   which are unallocated;

7   identifying blocks within the plurality of blocks for use by a set of I/O operations

8   to store the data;

9   testing to either maximize chain lengths of read operations for calculation of

10 parity, or to place the data with a high degree of locality in the plurality of storage

11 devices, the testing ~~having the steps~~ comprising,

12 determining, for both maximizing chain length and placing the data with ~~a~~ the

13 high degree of locality, ~~the~~ a number of read operations needed to ~~compute~~ calculate

14   parity for the data, by ~~computing~~ calculating parity using both ~~the~~ a subtraction method

15   of ~~computing~~ calculating parity and ~~the~~ a recalculation method of ~~computing~~ calculating

16   parity;

17   ~~firstly~~ first choosing to either maximize chain lengths of read operations for

18   calculation of parity or to place the data with ~~a~~ the high degree of locality in the plurality

19   of storage devices, and after ~~this~~ the first choice, secondly choosing either the subtraction

20   method of ~~computing~~ calculating parity or the recalculation method of ~~computing~~

21   calculating parity by determining which of these methods requires ~~the~~ a fewest number of

22   read operations,

23   choosing ~~the~~ which method ~~requiring~~ requires the fewest number of read

24   operations of ~~computing~~ calculating parity of the data; and

25   writing the data to the identified blocks, and ~~computing~~ calculating parity for the

26   data using the ~~chosen~~ which method ~~of computing parity~~.

1   51. (Currently Amended) A computer-_-_readable media, comprising:

2   said computer readable media containing instructions for execution on a processor

3   for a method of managing storage of data in a plurality of storage devices, each storage

4   device having a plurality of blocks for storing data, the method ~~having~~ comprising,

5   generating block layout information; and

6   in response to the block layout information, controlling ~~the~~ execution of an I/O

7   operation by identifying a plurality of contiguous storage blocks on a single storage

8   device for use by the I/O operation so as to ~~substantially~~ minimize ~~the~~ a number of read

9   operations needed for calculation of error correction parameters across a stripe by

10   determining whether a parity subtraction method or a recalculation method requires a

11   fewest number of read operations to calculate parity for the I/O operations and selecting

12   ~~a~~ the parity subtraction method or ~~a~~ the recalculation method for parity calculation based

13   on ~~the~~ which method ~~that~~ requires the fewest number of read operations ~~to compute~~

14   ~~parity~~.